Innovative NewSpace Ground Segment – Global Coverage Available Through the Cloud

Small Satellite Conference 2016

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Kongsberg Satellite Services

- HQ in Tromsø, Norway
- Branch offices at Svalbard, Oslo, Stockholm and San Francisco
- 160 employees
- Support of about 23 000 satellite passes monthly
- World's largest commercial ground station service provider
- Operates 15 ground station facilities including both Antarctic and Arctic locations

NewSpace Mission Characteristics

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NewSpace Missions are:

- **Often Built to address a commercial market**
  - **Remote Sensing, Communication, Internet of Things, AIS, ADS-B**
  - **Value lies in fast response**
  - **Near real-time data availability requirements**
  - **Ground Segment is a crucial part of the delivery chain**

- **Low to Extremely Low Cost**
  - **Satellite unit costs have reduced dramatically**
  - **Innovative launchers will lead to cheaper access to space**
  - **Ground Station Services are expected to follow**

- **Based on small satellites**
  - **Producing Large amounts of data**
  - **Satellites with lower power availability**
  - **Smaller Satellites should require larger ground stations !?**

Constellation Mission Characteristics

NewSpace Constellations are:

- Enabling near real-time services

- **Constellations improve the temporal resolution of satellite coverage**
- **(Near) Real Time availability of data is the driver behind constellations**
- **Access to the satellites multiples times per orbit**
- **Multiple sites and multiple antennas needed**
- **The potential can only be exploited with an efficient global ground network**

Ground Station Network Trade-offs

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- **Hardware**
  - **Antenna size**
    - **Find the sweet spot betwen cost and performance!**
    - **Key Driver of implementation cost!**
    - **Cost increases by the square of the antenna size**
  - **Cost-efficient and flexible back-end equipment based on COTS**

- **Standardization**
  - **Critical to reduce costs**
  - **Relevant to mission preparation, hardware maintenance costs, reducing technical risk**
  - **Unifying ground station network interfaces**

- **Service level**
  - **Flexible service levels representing the phase of the mission and the business**
  - **For commercial services, operators need high service level**
  - **Service ramp-up following the roll-out of satellites and business volume**
  - **SmallSat Ground Station Service does NOT mean low quality!!!**

Ground Station Network Trade-offs

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- «Future-proof» frequency capabilities
  - UHF Interference Issues
  - S/X-band is proven and most commonly used
  - Ka-band usage expected to develop
  - Optical links?

- Site positioning and diversity
  - Majority of LEO constellations are in polar orbits
    - Polar ground station sites solve a large part of the challenge!
  - Non-polar orbits become more common as well
    - Greater diversity of locations required

- Cloud Integration
  - Automated Machine-to-Machine or web-based Scheduling
  - Leads to lower cost and higher flexibility
  - Data Distribution towards commercial cloud operators or hosted servers at ground station sides
  - Integrated Network with one single point-of-contatc

KSAT Lite Technical Details

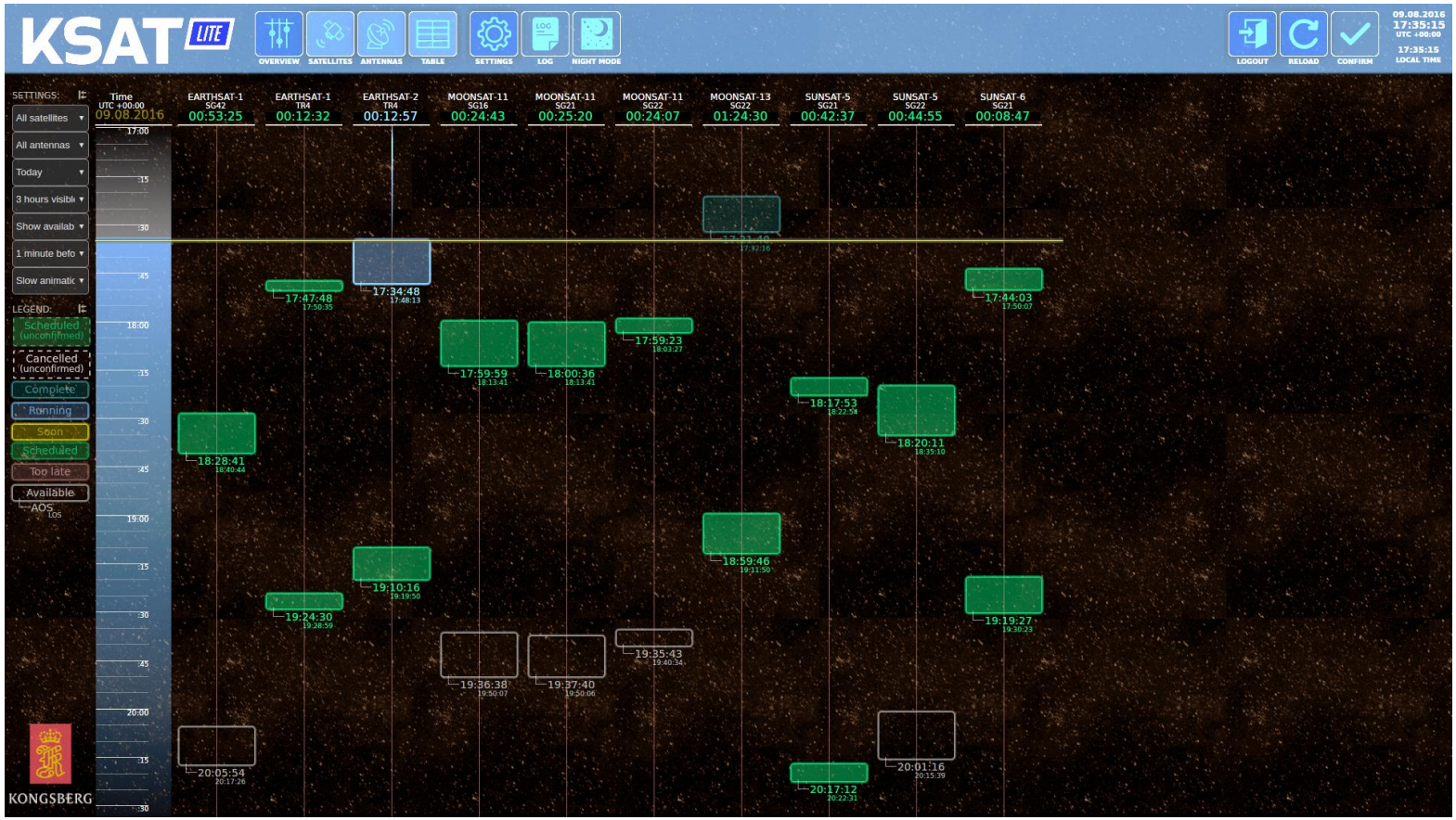
- 3.7 m S (up&down) and X Band (down) antennas, UHF antennas globally
- S-Band Rx G/T ca 12,5 dBK
- X-Band Rx G/T ca 27 dBK
- KSAT Backend or “Bring your own Device”

KSATlite	Baseline 3.7	UHF/VHF	Ka-band
Receive	X-band S-band	UHF VHF	Ka-band -
Transmit	S-band	UHF	-
Backend	KSAT Standard BYOD	KSAT Standard BYOD	KSAT Standard BYOD

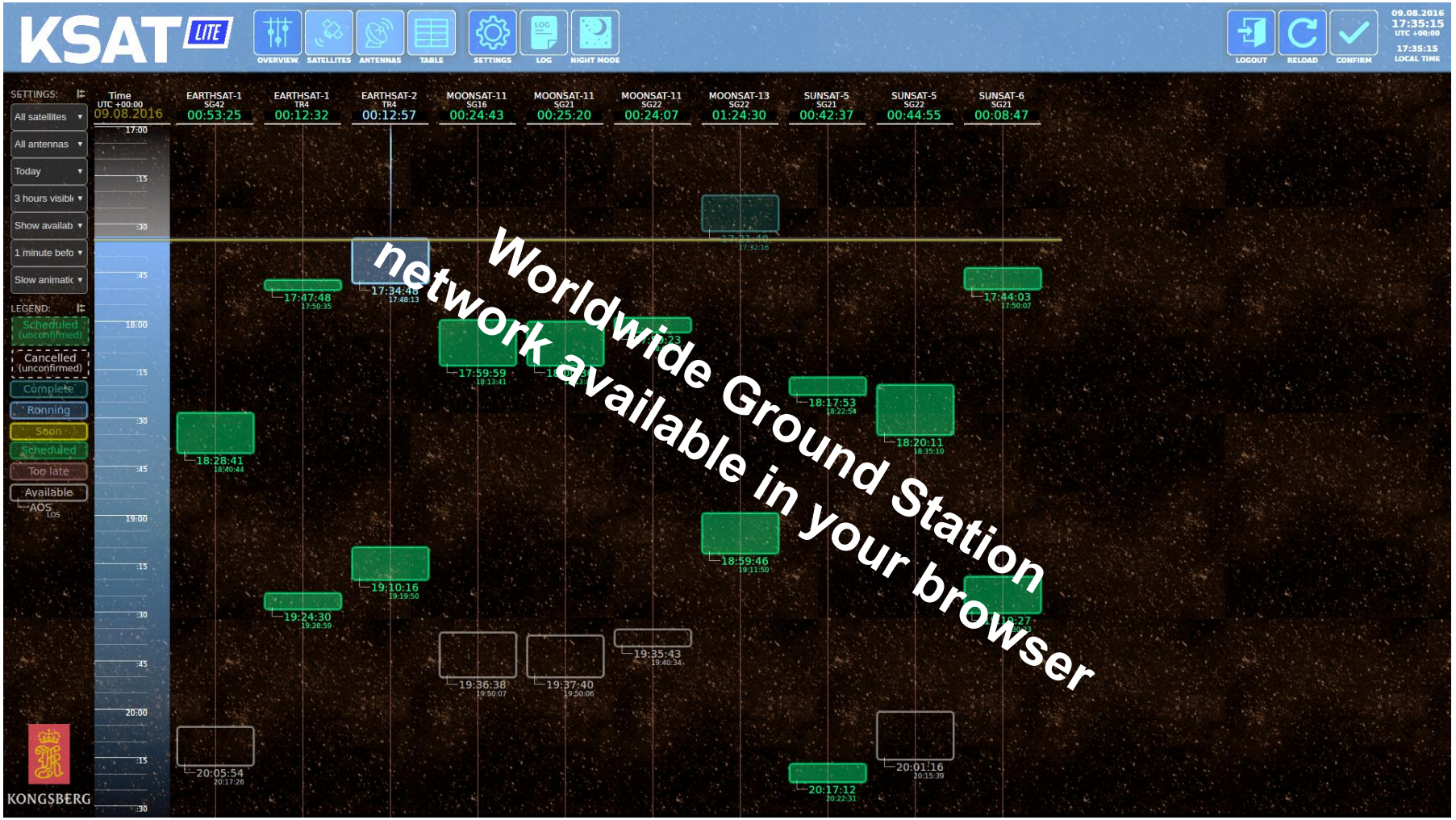
- **Ka-band** is emerging as operational downlink
  - Ideal locations in extremely dry Arctic and Antarctic climate
  - Less Rain – More Gain

Cloud based Scheduling

- Single Point of Contact for entire global network
- Automated Machine-to-Machine scheduling is the standard
- Visiual Representaiton of schedule and manual short term scheduling



Cloud based Scheduling



KSAT GLOBAL NETWORK

KSAT GROUND STATION

KSAT PARTNER STATION

KONGSBERG

KSAT Lite - Communication

- All sites have connectivity to international fiber communication networks -> possibility for high bandwidths
- KSAT provides large bandwidths to all sites
- Hosting of servers at KSAT data center possible
- Integrated Data Delivery to Cloud solutions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KSAT GROUND STATION
KSAT PARTNER STATION
KONGSBERG
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AVAILABLE TODAY!
VARDØ
INUVIK
TROMSØ TNOC
FAIRBANKS
GRIMSTAD
SPAIN
TOKYO
CALIFORNIA
AZORES
DUBAI
HAWAII
PANAMA
CENTRAL AFRICA
BANGALORE
SINGAPORE
MAURITIUS
HARTEBEESTHOEK
CORDOBA
NEW ZEALAND
SOUTH AMERICA
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